COMMENTS BY THE TEXAS COMMISSION ON ENVIRONMENTAL QUALITY REGARDING ADVERSE EFFECTS OF STRATEGIES FOR ATTAINMENT AND MAINTENANCE OF NATIONAL AMBIENT AIR QUALTY STANDARDS; EPA DOCKET ID NO. EPA-HQ-OAR-2018-0365

I. Summary of Notice

On June 26, 2018, the United States Environmental Protection Agency (EPA) issued a call for information in the *Federal Register* concerning adverse impacts of strategies for attainment and maintenance of the National Ambient Air Quality Standards (NAAQS). The information is requested to facilitate the Clean Air Scientific Advisory Committee's consideration of adverse public health, welfare, social, economic, or energy effects, which may result from various strategies implemented for attainment and maintenance of the NAAQS.

II. Comments

1. The Texas Commission on Environmental Quality (TCEQ) supports the EPA's and the Clean Air Scientific Advisory Committee's consideration of possible adverse impacts from strategies for attainment and maintenance of the NAAQS.

As discussed in the detailed comments below, strategies to help nonattainment areas attain and maintain compliance with the NAAQS can have numerous adverse impacts. While the United States Supreme Court has ruled that the Federal Clean Air Act (FCAA) bars cost considerations in the NAAQS-setting process, economic and other adverse impacts resulting from strategies for attainment and maintenance of the NAAQS should be considered in other policy and regulatory actions by the EPA concerning the NAAQS. The TCEQ supports the EPA's and the Clean Air Scientific Advisory Committee's efforts to consider these adverse impacts. Specific examples of adverse impacts from such strategies are provided below.

2. In considering the adverse effects, which may result from various strategies for attainment and maintenance of existing, new, or revised NAAQS, the EPA and the Clean Air Scientific Advisory Committee should consider the cost to state agencies associated with the development of state implementation plan (SIP) submittals.

The development of nonattainment area SIP revisions is necessary not only to meet FCAA requirements but also to help the state determine which strategies to implement for attainment and maintenance of the NAAQS. The cost of such SIP development is often an overlooked impact of an area's nonattainment status, and the burden on the state only increases as the EPA continues to raise the bar by increasing the stringency of the NAAQS. The EPA has historically either failed to account for or significantly underestimated such costs to state agencies. In addition to the work involved in the development of rules and other strategies as part of a SIP submittal, extensive technical support, including modeling, data analysis and corroborative technical evaluations is required. Major activities performed to support photochemical modeling for these demonstrations include the development of meteorological fields, air pollutant and source category emissions inventories (point, mobile, non-road mobile, area and biogenic), analysis of trends in air quality to evaluate ambient pollutant concentrations and meteorological data to help predict progress toward meeting standards and to assess the causes of high pollutant concentrations. There is additional burden to the states when relevant guidance is not released in a timely manner. States must develop technical work according to draft guidance that may be available at the time, without a clear indication that the work will be approved by the EPA. Technical work required for SIP development is extremely burdensome for states with fewer technical resources, and also for states like Texas, which have multiple nonattainment areas.

The TCEQ has previously provided estimates of the burden to the state associated with SIP development for nonattainment areas in Texas in response to Information Collection Requests (ICR) from the EPA [TCEQ Comments on *EPA ICR No. 2236.04* (EPA Docket ID NO: EPA-HQ-OAR-2003-0079) and *EPA ICR NO. 2347.03* (EPA Docket ID NO. EPA-HQ-OAR-2010-0885)]. The TCEQ has estimated that the burden *in each* Texas nonattainment area to develop required SIP submittals to continue implementing the 2008 ozone NAAQS would range between 45,000 to 50,000 hours of labor and result in an estimated total cost of approximately $2 million.

3. While evaluating exceptional events and international emissions are not *per se* "strategies for attainment and maintenance of the NAAQS," states are still required to expend significant resources evaluating these issues to determine which strategies will help attain and maintain compliance with the NAAQS, particularly as the EPA adopts more stringent NAAQS that approach background concentrations of some criteria pollutants.

When an area is designated nonattainment, states expend significant resources to determine which strategies to implement. Some strategies are fundamentally required to meet FCAA requirements, such as implementing reasonably available control technology (RACT), as discussed below. However, the most effective strategies to address an area's nonattainment with the NAAQS must be targeted, such as focusing on specific precursor pollutants or specific sources. When implementing the NAAQS, state agencies must evaluate exceedance days for potential causes. This evaluation may reveal that the exceedance was primarily caused by local emissions and conducive meteorology, or the exceedance was due to events or emissions outside the control of the state. For example, exceptional events and non-United States emissions can cause an area to be unable to attain the NAAQS. In these instances, the TCEQ evaluates exceedance days for potential exceptional events and submits these demonstrations when the event impacts a regulatory decision. The TCEQ also evaluates emissions from outside the United States for impact on NAAQS levels in Texas and submits FCAA Section 179(b) petitions to the EPA if these emissions have an impact on NAAQS compliance or maintenance. This evaluation is increasingly important as the EPA continues to lower NAAQS to levels approaching background concentrations entering nonattainment areas.

Exceptional event demonstrations are extremely resource-intensive, due both to the EPA's guidance for implementing the Exceptional Event Rule and the way in which the EPA evaluates these demonstrations, often asking for additional information. Based on recent experience developing and supporting wildfire-related exceedances of the ozone NAAQS, it is likely that most demonstrations submitted by the TCEQ would be Tier 3, which are the most challenging to support. This is due to the complex nature of ozone chemistry when affected by wildfire emissions (Jaffe et. al., 2013) at long distances. At least one full-time senior scientist is needed to screen every exceedance day and produce exceptional event demonstrations for all identified events. Alternatively, contractors can be utilized, requiring hundreds of thousands of dollars annually.

For FCAA, Section 179(b) petitions addressing exceedances caused by foreign emissions sources, source apportionment modeling is required by the EPA to determine foreign contribution. States need to assess the contributions from Canada, Mexico, northern Central America, and conduct some assessment of contribution from Asia. Global modeling, such as GEOS-chem is required to quantify the influence of distant sources on pollutant concentrations at the modeling domain boundaries. It is necessary to obtain the most recent emissions data and metadata from international organizations and United States agencies that use it for global-scale modeling (examples of global emissions clearinghouses include the Global Emissions Initiative (GEIA) and the Emissions Database for Global Atmospheric Research (EDGAR)). If the FCAA Section 179(b) petition is a component of the "regular" attainment demonstration SIP, documentation efforts are somewhat increased, and typically require contract assistance and several hundred thousand dollars per demonstration. It would be helpful if the EPA provided estimates of international impact for use by states in preparing SIPs.

Additional monitoring assets and operations for monitoring sites in rural areas and along the Texas coast would be helpful to allow stronger demonstrations using this additional data collection. Based on past conversations with regional EPA staff, this type of data would be helpful when distinguishing between impacts of recirculated Texas emissions versus incoming background levels of relevant pollutants. The enhanced monitoring would also provide resources for improving the global emissions inventory data, ozone sonde measurements, radar profilers, and analysis of chemical isotopes, boundary layers, and aerosol profiles and would require more than half a million dollars to implement. In addition, offshore monitoring could also be helpful to measure incoming air quality at an unknown cost.

4. The costs of control strategies for emission reductions to attain and maintain compliance with the NAAQS are significant but vary substantially depending on the specifics of the nonattainment area. As EPA adopts more stringent NAAQS, costs escalate especially if emissions reductions from areas outside the nonattainment area are needed, but the EPA has underestimated such costs in previous regulatory actions.

The TCEQ has implemented many control strategies in Texas for reducing emissions to attain the ozone NAAQS. The exact costs of compliance with emission control strategies applied to any particular ozone nonattainment area depend heavily on what sources are located in that nonattainment area and the strategies applied. In the December 2006 proposal of the Dallas-Fort Worth 1997 Eight-Hour Ozone Attainment Demonstration SIP Revision, the TCEQ proposed control strategies for nitrogen oxides (NO_x) in sources inside and outside the nonattainment area. At proposal, the total costs over the first five years the rules would be in effect was estimated to range between $255 to $351 million. In the August 2000 proposal of the Houston-Galveston-Brazoria (HGB) Ozone Attainment Demonstration SIP revision for the one-hour ozone NAAQS, the TCEQ's proposed 90% NO_x control strategy for the HGB area was estimated to have a total capital cost of approximately $2.7 billion with an increased annual cost of approximately $597 million. While the final rules were adopted with revisions that may have mitigated costs (e.g., the HGB NO_x control strategy was revised to target an overall 80% reduction), these cost estimates show the significant potential costs that can result from strategies for attainment and maintenance of the NAAQS.

When the EPA was considering the appropriate level for the 2015 ozone NAAQS, the TCEQ commissioned a study by NERA Economic Consulting (NERA) to assess the impact of a 65 parts per billion (ppb) NAAQS (Economic Impacts of a Proposed 65 ppb National Ambient Air Quality Standard for Ozone on the State of Texas, August 26, 2015). As part of the study, NERA evaluated the EPA's cost estimates from the Regulatory Impact Analysis (RIA) from the proposed 2015 ozone NAAQS. The EPA's RIA indicated that significant emission reductions outside the expected nonattainment areas in Texas would be necessary for the state to reach attainment. Based on information from the EPA's RIA, NERA estimated the EPA's annualized cost to range between $3.6 to $5.7 billion dollars (2011$). However, the bulk of these annualized costs were from unknown controls that EPA assumed a $15,000 per ton cost, ranging from $3.2 to $5.3 billion. Because these were unknown as to which sources would be regulated and what controls might be needed, the EPA's assumed $15,000 per ton is questionable. Further, controls implemented on smaller sources or on sources that are already controlled typically have a higher cost per ton of pollutant reduced. Therefore, the EPA's assumption of a flat cost per ton of unknown controls was not reasonable. NERA's estimated annualized cost of compliance for Texas with a 65 ppb standard was between $47 and $51 billion, approximately $45 to $49 billion being for the unknown controls. The NERA study for a 65 ppb NAAQS is included with the TCEQ's comments as Appendix A.

5. Implementation of volatile organic compound (VOC) control techniques guidelines (CTG) as presumptive RACT under FCAA, §182(b)(2) and §172(c)(1) can result in the unnecessary economic burden of imposing regulations that would not contribute to attainment or maintenance of the ozone NAAQS.

The intent of a CTG document under FCAA, §182(b)(2) and §172(c)(1) is to provide states with available control technology information for the implementation of VOC RACT to help certain nonattainment areas attain the ozone NAAQS. For areas that are VOC-limited, the CTG-recommended controls may provide a net ozone benefit and could contribute to attainment. However, for areas that have been demonstrated through photochemical modeling to be primarily NO_x-limited rather than VOC-limited, the CTG-recommended controls are unlikely to provide a net ozone reduction benefit at the design value monitor and will not help contribute to attainment of the ozone NAAQS. Requiring states to implement the CTG recommendations in areas demonstrated to have low sensitivity to VOC emissions reductions in terms of ozone formation is inconsistent with the primary mandate in §172(c)(1) to provide for attainment of the NAAQS. Furthermore, while the EPA claims that CTGs are only guidance documents, the EPA's policy is that CTGs establish presumptive RACT, which must be adopted and implemented by states. Once the EPA adopts a CTG, states have very little flexibility and are required to implement the CTG recommendations regardless of whether the CTG will actually result in ozone reductions in their nonattainment areas. This results in the unnecessary economic burden imposed by adopting regulations that will not contribute to attaining the ozone NAAQS. In addition to the potential for adverse economic impacts, the unnecessary control of VOC could result in negative environmental impacts associated with increased emissions of other pollutants. If combustion devices such as flares are used to control VOC to meet presumptive RACT requirements, there could be an associated increase in emissions of NO_x, sulfur dioxide (SO_2), carbon monoxide (CO), or other undesirable by-products of combustion. An increase in NO_x emissions could result in an overall negative impact on ozone levels in areas that are NO_x-limited rather than VOC-limited.

6. Nonattainment designations trigger more stringent Nonattainment New Source Review (NNSR) permitting. More stringent NNSR permitting not only has direct economic impacts but can also discourage or disincentivize development and economic growth in nonattainment areas due to the increased costs and additional practical burdens such as delays in the permitting process.

A NNSR application could be required for permit applicants seeking a permit in a nonattainment area for a new major stationary source or major modification to a stationary source. NNSR imposes additional permitting requirements such as a Lowest Achievable Emission Rate (LAER) technology evaluation and emissions offsets, which are not applicable in attainment areas. As identified below, certain aspects of these NNSR requirements can result in adverse economic impacts and other practical concerns.

LAER is the most stringent emission limitation either contained in the SIP or TCEQ rule for the source, or achieved in practice by such class or source category. Unlike a Best Available Control Technology evaluation, LAER does not consider economic impacts or economic feasibility. This can result in situations where a new facility or expansion project that would otherwise be feasible cannot be pursued in a nonattainment area. This has a direct, adverse impact on economic activity in nonattainment areas.

Offsets are actual emission reductions of the pollutant or precursor pollutant that is proposed to increase and must be obtained prior to operation. The offset ratio depends on the nonattainment classification and reductions must offset the proposed emissions increase. For example, a major source with a proposed increase of 40 tons per year (tpy) of VOC and a 40 tpy increase of NO_x in a moderate ozone nonattainment area with an offset ratio of 1.15 to 1 must provide offsetting emission reductions of 46 tpy of VOC and 46 tpy of NO_x.

These additional permitting requirements can result in several challenges for the nonattainment area. For example, owners or operators of sources seeking to locate or expand in a nonattainment area would need to obtain offsets, which could be difficult to obtain in newly designated nonattainment areas. The cost of offsets and lack of availability could lead existing sources to reconsider expansion plans or relocate projects to other areas and cause new sources to selectively be placed outside of nonattainment areas.

In addition, the more stringent requirements for NNSR complicate the permit review process and may cause potential delays. Depending on the complexity of the project, delays could be on a scale of months to years. These delays could limit economic growth while new projects navigate the complex NNSR permitting process.

7. In addition to more stringent permitting requirements such as LAER, sources in nonattainment areas must obtain offsets for increases in emissions for sources that exceed FCAA thresholds. Emission reduction credits (ERC) are most commonly used to meet FCAA offset requirements and can result in significant additional costs to construction of new facilities or expansions at existing facilities.

As discussed above, the FCAA requires that sources in nonattainment areas offset increases in emissions that result from the installation of a new major source or a major modification at an existing source. For ozone nonattainment areas, not only does the major source/major modification threshold become more stringent at higher classification but the offset ratios increase as well. Emissions offset requirements are most commonly met through the use of ERCs, ton per year credits generated from emission reductions on separate sources. While ERCs can be used for other purposes, such as compliance with state rule emission requirements, nearly all uses of ERCs are for permitting offset requirements.

The TCEQ Emission Banking and Trading credit programs are free market systems. As such, the price of ERCs is subject to market forces such as supply and demand. High demand and short supply can result in severe price spikes, as is illustrated by recent history in Texas. Figure 1 shows weighted average ERC prices from 2006 through August 2018 for NO_x and VOC credits. Figure 2 shows the total dollar and number of trades over the same period. Note that the data used for these graphs only include nonzero-dollar trades. Zero-dollar trades are generally trades between co-owned facilities and do not reflect actual market value for credits.

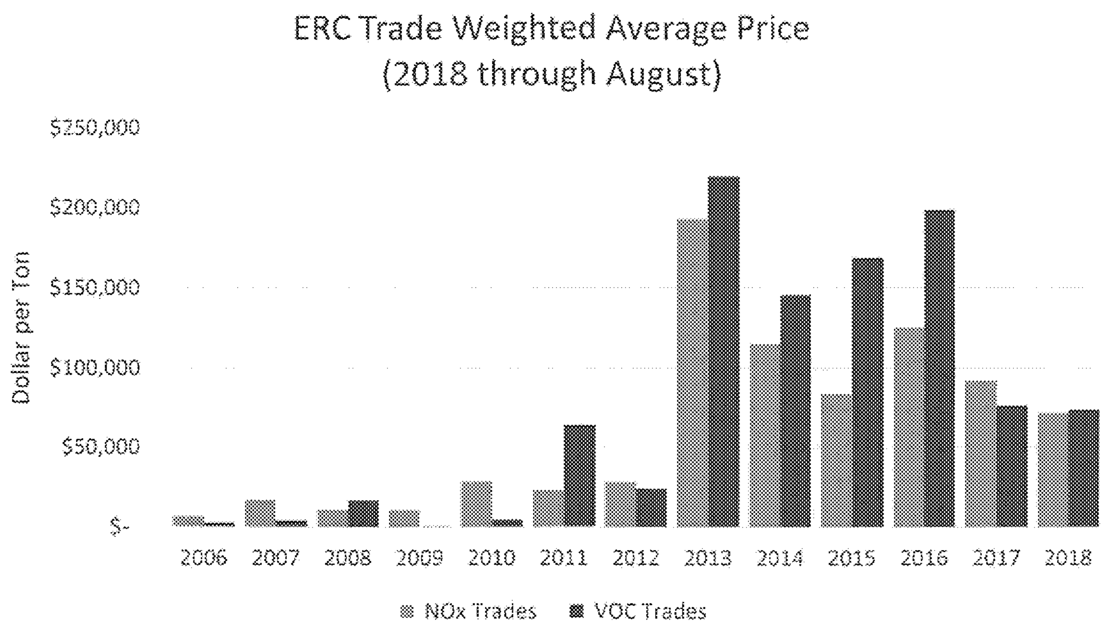

Figure 1: ERC Trade Weighted Average Price. Nonzero-dollar trades only. Dollar per ton values are not annualized.

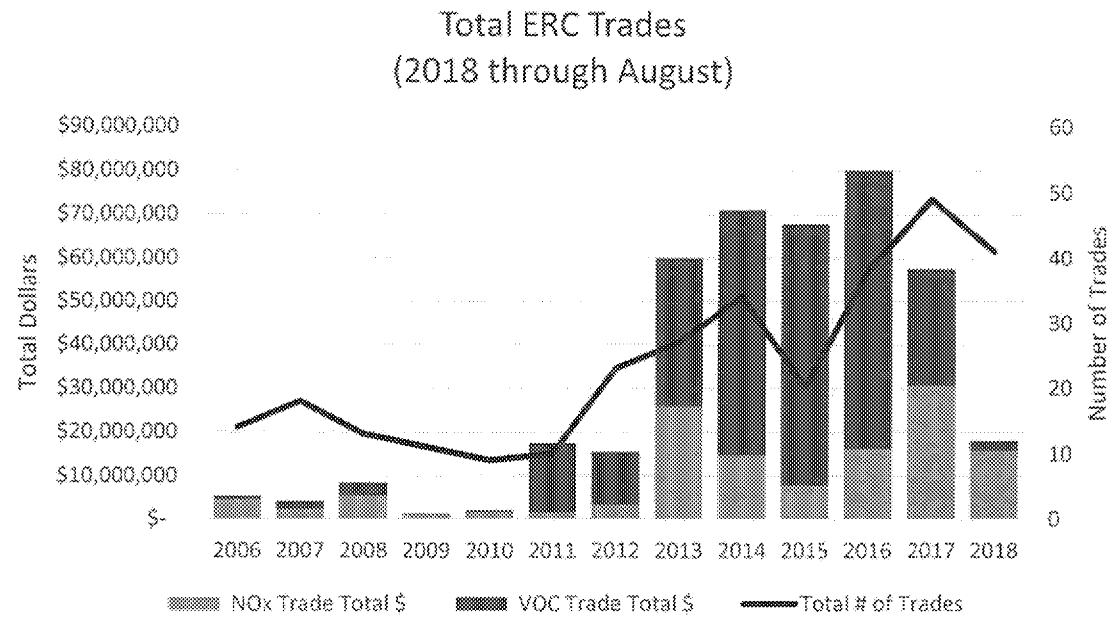

Figure 2: Total ERC Trades. Nonzero-dollar trades only. Total dollars represent capital costs and are not annualized.

Nearly all the ERC trades illustrated in Figures 1 and 2 occurred within the HGB ozone nonattainment area. As Figure 1 illustrates, ERC prices spiked in 2013 and have only recently started downward but are still substantially higher than pre-2011 prices. The need for offsets has a significant cost impact on companies building new or expanding existing facilities. From 2013 through 2017, $336 million were expended in purchasing ERCs in Texas, 99.6% of which was in the HGB area.

8. Economic impacts from a nonattainment designation for the NAAQS can be significant even when direct control strategies for attainment (e.g., RACT) are not required.

Economic impacts associated with an area being designated nonattainment for the NAAQS can be quite varied and extreme. For ozone nonattainment areas, the classification of the area (i.e., marginal, moderate, serious, severe, or extreme) has a substantial impact on the strategies required, particularly for areas classified as moderate or worse. However, even areas classified as marginal can be severely impacted. As discussed above, permitting requirements in nonattainment areas, even marginal ozone nonattainment areas, can be a significant burden and may discourage companies from starting manufacturing businesses in that area if other available locations are designated attainment and subject to less stringent requirements. Existing facilities may choose to not expand operations in a nonattainment area and instead either build new or expand facilities in other areas. Cities located in nonattainment areas as well as the state are negatively impacted economically in the form of lost potential jobs, lost tax revenues, etc., when possible future business opportunities or expansions at existing companies are moved to areas outside the nonattainment area and possibly outside Texas.

In a recent study conducted for the Alamo Area Council of Governments (AACOG) and under contract with the TCEQ (Contract No. 582-16-60180, Potential Cost of Nonattainment in the San Antonio Metropolitan Area, February 17, 2017), the potential cost of an ozone nonattainment designation in the San Antonio area was evaluated considering both marginal and moderate classifications. The study considered a range of potential economic impacts, such as loss of business expansion or location, permitting costs, conformity impacts, and controls on stationary sources. The study included eight counties, including Bexar County. In the EPA's final designations for the 2015 Ozone NAAQS, only Bexar County was designated nonattainment in the San Antonio area with a marginal classification. The study concluded that a marginal classification for the eight-county area would result in total costs ranging from $3.2 to $27.5 billion and $2.1 to $21.5 billion for Bexar County alone. A significant portion of the cost and the wide range is from the impact of possible lost manufacturing company expansions or relocation, which for the entire eight-county area ranged from approximately $700 million to $25 billion. The AACOG study is included with these comments as Appendix B.

9. Regulatory costs from attainment and maintenance of NAAQS can lead to adverse public health effects.

To address the question of whether there are adverse public health effects from attainment or maintenance of the NAAQS, the EPA should investigate literature that addresses the health impacts of regulatory costs. There are several ways that public health could be adversely impacted by regulatory costs, including lost opportunity costs. For example, if goods and services cost more or if people have a reduced income or slower income growth, then people have less money to spend on goods or services that enhance their safety and health. Increased costs can also affect psychological health. The type of analysis that determines these health opportunity costs has been called health-health analysis.

The study of health-health analysis has largely been carried out in the field of economics. This field began with the concept (known since the 1800s) that people who are wealthier are healthier – this is now called the income-health gradient. The Office of Management and Budget used this type of analysis in the early 1990s when assessing regulations (reviewed in Lutter & Morrall, 1994). Health-health analysis considers both the intended and unintended health effects of a regulation (i.e., the health benefits and dis-benefits). There have been studies that assessed the potential health impacts of increasing costs of regulations (e.g. Lutter, Morrall, and Viscusi, 1999). These types of studies can help provide estimates of the health costs of regulations.

For example, Lutter et al. (1999) estimated that there is one life lost for every $25 million (2011$) increase in regulatory costs. The ozone NAAQS 2015 RIA estimated that the cost of attaining a 70 ppb standard is $1.4 billion (US EPA 2015). This would equate to 56 lives using the Lutter et al. estimate. This dis-benefit estimate could be compared to the EPA's estimate of reduction of premature mortality of 96 to 160 lives from reductions in ozone concentrations. For a 65 ppb ozone standard, the EPA's cost estimate was $16 billion (equating to 640 lives per Lutter et al.), compared to the EPA's premature mortality reduction estimates of 490 – 820. Differences in estimates of costs or of ozone-induced premature mortality (e.g., Lange, Mulholland, and Honeycutt, 2018) could change the ratio of these two numbers and impact the perception of benefits versus dis-benefits from a rulemaking. Therefore, the EPA should conduct these types of analyses to provide information about both the intended and unintended consequences of a rulemaking.

In addition, limited information can be gleaned from retrospective accountability analyses. These studies have many uncertainties, including lack of counterfactual controls and reliance on modeling; however, some have cast doubt on the predictive ability of health estimates from key epidemiology studies. For example, Cox and Popken (2015) found that the predicted reduction in premature mortality due to decreasing ambient particulate matter and ozone concentrations was either not present or overestimated. Peel et al. (2010) found no reduction in emergency department visits for cardiovascular or respiratory health outcomes in adults or children during the 17-day period of the Summer Olympic Games in Atlanta, Georgia, during which time ozone concentrations had decreased 20-30%. As highlighted in these studies and TCEQ comments on previous NAAQS assessment documents, the EPA should not only evaluate published scientific studies, but also conduct an uncertainty analysis of the available literature to more fully characterize the strength of scientific understanding. These types of analyses can provide information about our confidence in both the benefits and dis-benefits from a regulatory decision and should be included in the EPA's benefit analyses in assessing the appropriate level of a NAAQS.

10. NO_x dis-benefits can increase ozone concentrations in highly populated areas, possibly resulting in adverse health impacts.

During the review of the 2015 ozone NAAQS, the EPA presented risk estimates of ozone-induced mortality and morbidity in 12 study cities in their Health Risk and Exposure Assessment (HREA; US EPA, 2014). These risks were calculated based on measured ozone concentrations (either from 2006-2008 or 2008-2010), and on predicted ozone concentrations if those areas had met the 2008 standard or alternative ozone standards. The ozone-attributable mortality incidence is presented in Appendix 7B, for both absolute mortality incidence and changes in mortality incidence using the baseline ozone concentrations, or with concentrations predicted if the study city had met an ozone standard of 75 ppb, 70 ppb, 65 ppb, or 60 ppb. Of the 12 study cities using the 2009 baseline, none (0/11) showed a statistically significant decrease in mortality when going from the baseline to 75 ppb; 2/12 showed a significant decrease in mortality when going from 75 to 70 ppb; 3/12 showed a significant decrease in mortality when going from 75 to 65 ppb; and 3/11 showed a statistically significant decrease in mortality when meeting a standard of 75 ppb compared to meeting a standard of 60 ppb. Furthermore, several cities showed **increases** in mortality when meeting a lower ozone standard (4/11 for baseline to 75 ppb; 2/12 for 75 to 70 ppb; 1/12 for 75 ppb to 65 ppb). EPA did not calculate changes in risk in all studies cities for all levels of the NAAQS, either because a city had already attained a NAAQS level (Detroit at 75 ppb), or because the photochemical model could not model attainment of a standard for that city (New York, 60 ppb). The rest of the cities did not show statistically significant changes in mortality predicted from these relatively large changes in the ozone NAAQS.

The reason for this lack of benefit from decreasing the ozone standard can be found in the HREA, and in our understanding of ozone chemistry. The ozone standard regulates **peak** ozone concentrations – i.e. the 4th highest daily eight-hour maximum concentration. However, the estimates of mortality are based on the seasonal **mean** ozone concentration. Seasonal ozone means are less responsive to emissions decreases than peak ozone, and sometimes mean ozone concentration can even increase with decreasing emissions (Downey et al. 2015; Simon et al. 2015; Lange 2018). The increases (or lack of decrease) in mean ozone is more likely in areas with higher population (urban core areas), as is demonstrated in the HREA Appendix 4. Appendix 4 shows that there is generally a greater decrease in ozone peak concentrations and seasonal averages in less densely populated areas, with some study cities/time frames having increases in the 4th high ozone concentration, and particularly increases in the seasonal average with decreases in the ozone standard (Figures 4D-115 to 4D-129, pp 312-326). This means that more people in the urban core can be exposed to higher average ozone concentrations with a decrease in the ozone standard. These patterns are mostly caused by the NO_x dis-benefit, which occurs because NO_x can contribute both to the formation and removal of ozone from the trophosphere. As NO_x concentrations decrease, ozone concentrations can actually increase. This can manifest as a decrease in the tails of the distribution of daily ozone concentrations in an area (Lange 2018). In addition, the location of peak ozone formation can change, such that more ozone formation occurs in more urban areas. Therefore, the EPA models a lack of benefits (and sometimes dis-benefits) from decreases in the ozone standard. The impact of changes in ozone formation with reviewing standards should be thoroughly investigated by EPA and presented to NAAQS reviewers when changing the ozone standard.

References

Cox, LAT and DA Popken. 2015. "Has reducing fine particulate matter and ozone caused reduced mortality rates in the United States?" *Annals of Epidemiology* 25: 162-173.

Downey, Nicole, Chris Emery, Jaegun Jung, Tanarit Sakulyanontvittaya, Laura Hebert, Doug Blewitt, and Greg Yarwood. 2015. "Emission Reductions and Urban Ozone Responses under More Stringent US Standards." *Atmospheric Environment* 101: 209–16. https://doi.org/10.1016/j.atmosenv.2014.11.018.

Lange, Sabine S. 2018. "Comparing Apples to Oranges: Interpreting Ozone Concentrations from Observational Studies in the Context of the United States Ozone Regulatory Standard." *Science of The Total Environment* 644 (2): 1547–56. https://doi.org/10.1016/j.scitotenv.2018.06.372.

Lange, Sabine S, Sean E Mulholland, and Michael E Honeycutt. 2018. "What Are the Net Benefits of Reducing the Ozone Standard to 65 Ppb? An Alternative Analysis." *International Journal of Environmental Research and Public Health* 15 (8): 1586. https://doi.org/10.3390/ijerph15081586.

Lutter, R, and John F Morrall. 1994. "Health-Health Analysis: A New Way to Evaluate Health and Safety Regulation." *Journal of Risk and Uncertainty* 8 (1): 43–66.

Lutter, R, John F Morrall, and WK Viscusi. 1999. "The Cost-per-Life-Saved Cutoff for Safety-Enhancing Regulations." *Economic Inquiry* 37 (4): 599–608.

Peel, JL, M Klein, WD Flanders, JA Mulholland, and PE Tolbert. 2010. Impact of Improved Air Quality During the 1996 Summer Olympic Games in Atlanta on Multiple Cardiovascular and Respiratory Outcomes. *Health Effects Institute Research Report* Number 148.

Simon, Heather, Adam Reff, Benjamin Wells, Jia Xing, and Neil Frank. 2015. "Ozone Trends across the United States over a Period of Decreasing NOx and VOC Emissions." *Environmental Science and Technology* 49 (1): 186–95. https://doi.org/10.1021/es504514z.

US EPA. 2014. "Health Risk and Exposure Assessment for Ozone (Final Report)."

———. 2015. "Regulatory Impact Analysis of the Final Revisions to the National Ambient Air Quality Standards for Ground-Level Ozone."